# Working memory

Psychology 248
Prof. Benjamin

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# Short-term vs. working memory

- Short-term memory is for *holding* information
- Working memory is for *manipulating* information.

# Working memory test

- http://cognitivefun.net/test/4

# Questions about working memory

- What does working memory do?
  - And how can we evaluate what it does?
- What are individual differences in WM related to?

# Search of memory

cheese
potato chips
soy sauce
heirloom tomatoes
linguine
light bulbs

Are you going to get linguine at the store?

# Memory search – subtraction method
## *Response-time measures of memory*

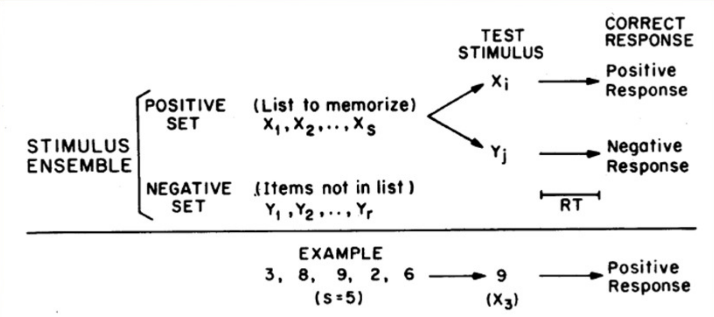
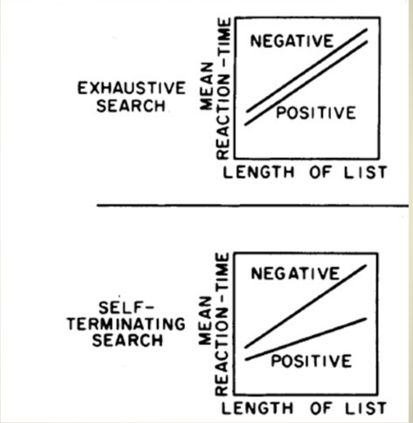


FIG. 2. Paradigm of item-recognition task (Exps. 1–5).

* Number of items in set was varied across lists *

Sternberg (1969)

# Predictions



# Results

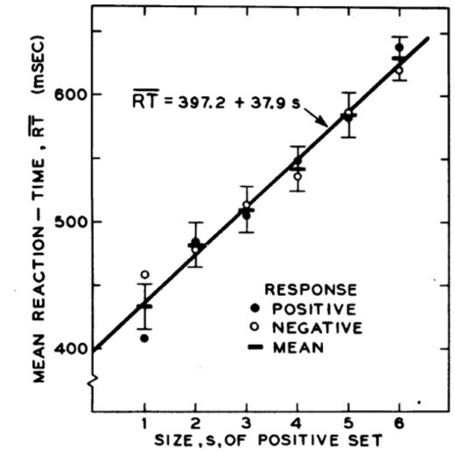
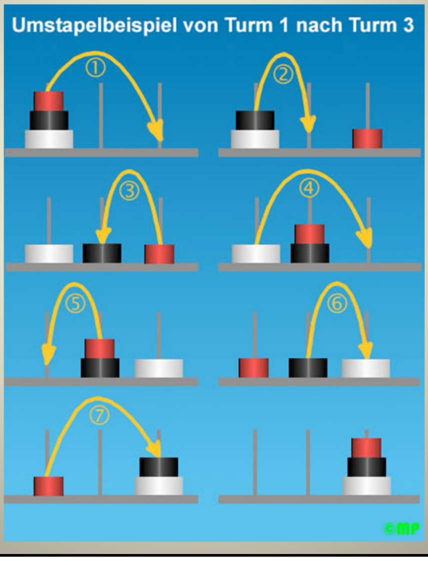


Fig. 4. Results of Exp. 1: Item-recognition with varied-set procedure. Mean latencies of correct positive and negative responses, and their mean, as functions of size of positive set. Averaged data from eight subjects, with estimates of $\pm\sigma$ about means, and line fitted by least squares to means.

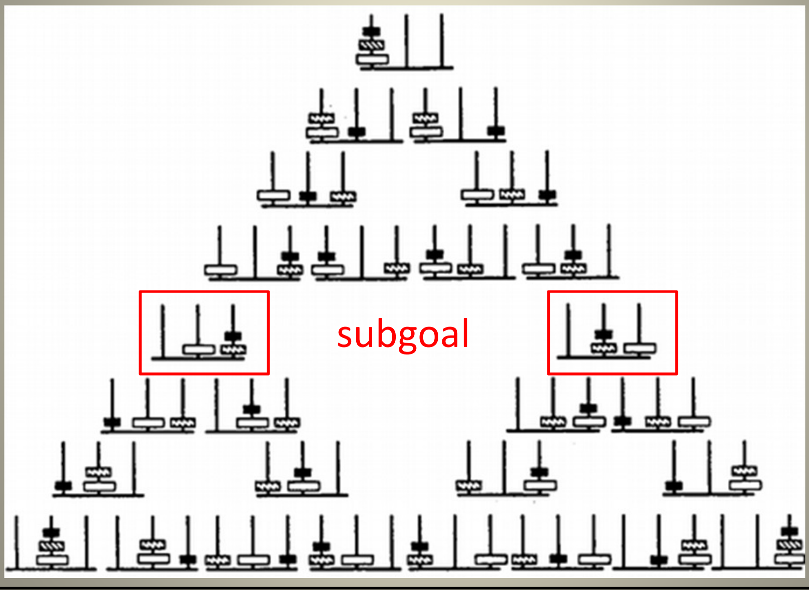
# Maintaining and updating memory: The Tower of Hanoi

- Rules of the game:
  - Try to get all the disks from the left post to the right post, stacked from big to small
  - Move one disk at a time
  - A big disk cannot be placed on a small disk.

# Tower of Hanoi



# Tower of Hanoi

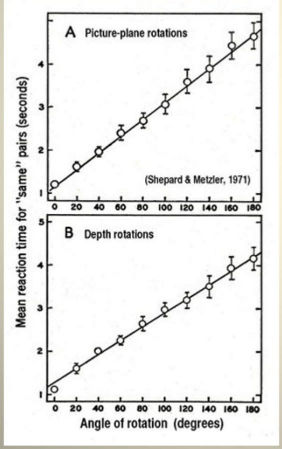


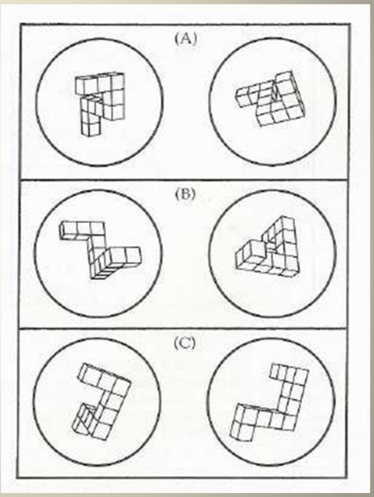
# Manipulating information in memory

- Mental rotation
- Mental map scanning
- Effects of size on judgments

# Mental rotation

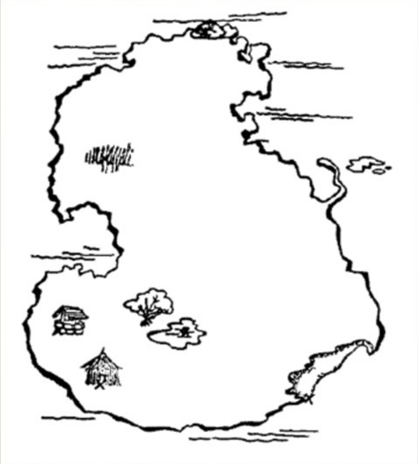
Are the two objects in each pair the same or different?



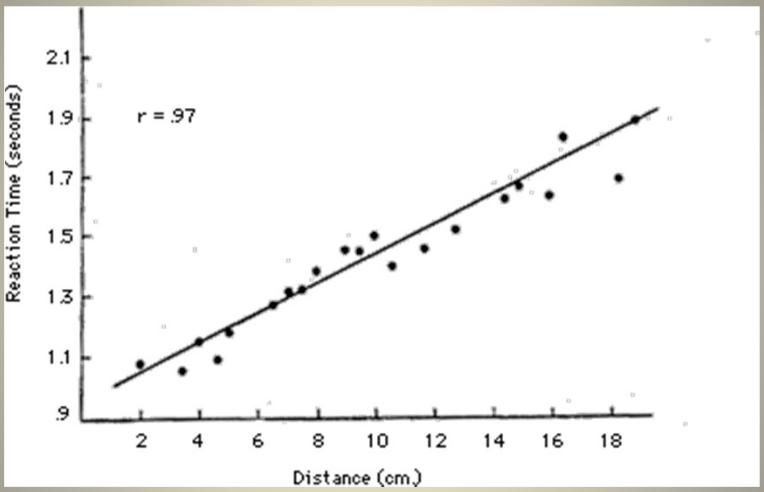


Shepard & Metzler (1971)

# Map scanning



- Subjects had to memorize map of island.
- During test, had to image the island.
  - given a starting location
  - given a target location
  - press button when have "located" target



# Effects of size

- Get ready to imagine something.

## Effects of size

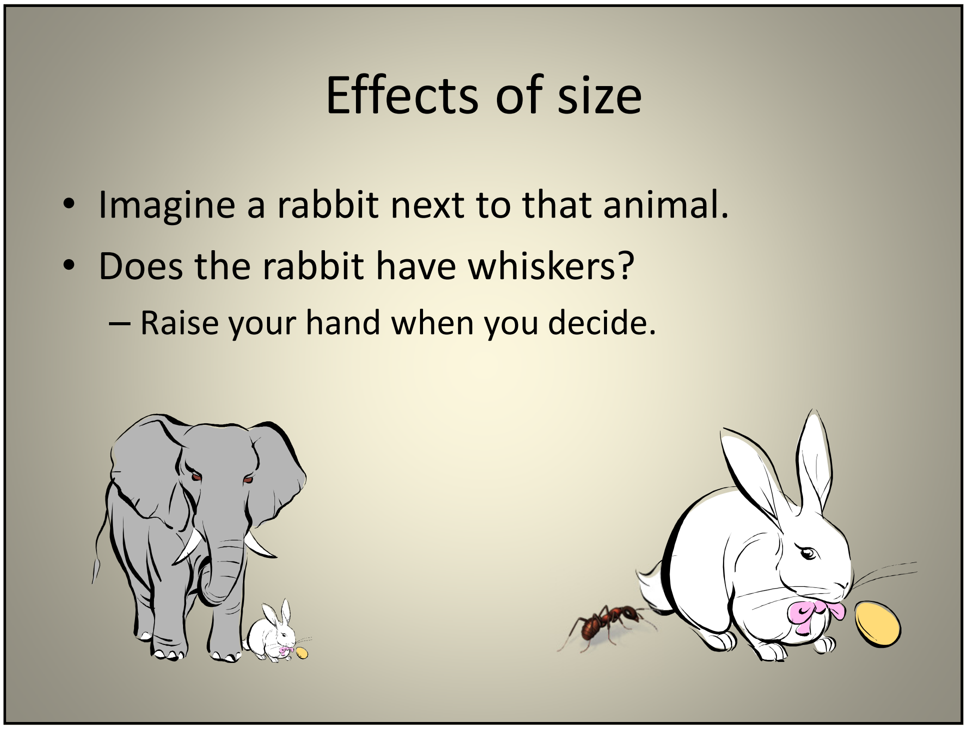
- Imagine an ANT.

## Effects of size

- Imagine an ELEPHANT.

# Effects of size

- Imagine a rabbit next to that animal.
- Does the rabbit have whiskers?
  - – Raise your hand when you decide.



# Effects of size

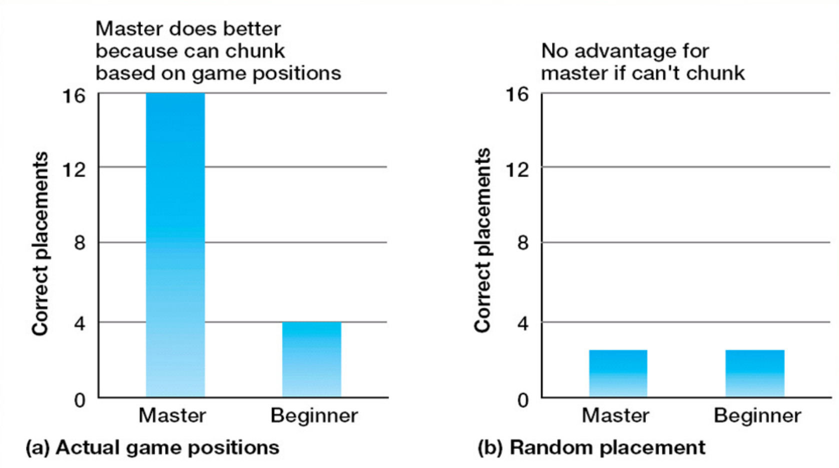
- Imagine a rabbit next to that animal.
- Does the rabbit have whiskers?
  - – Raise your hand when you decide.

# Expertise and memory capacity

- Chunking by chess experts
  - Experts: > 10,000 playing hours
  - Novices: < 100 playing hours
- Show novices or experts pictures of chess pieces on a board for 5 seconds
  - Chess pieces can be arranged in *actual game positions* or *randomly*
- Then ask subjects to recall the positions

Chase & Simon (1973)

# Expertise and memory capacity



Chase & Simon (1973)

# Expertise and memory capacity

- http://youtu.be/rWuJqCwfjjc

# Working memory and language comprehension

- Center Embedded
  - The reporter disliked the editor.
  - The reporter [ who the senator attacked ] disliked the editor.
  - The reporter [ who the senator [ who John met ] attacked ] disliked the editor.
- Right-branching
  - John met the senator who attacked the reporter who disliked the editor.

## Relationships to working memory

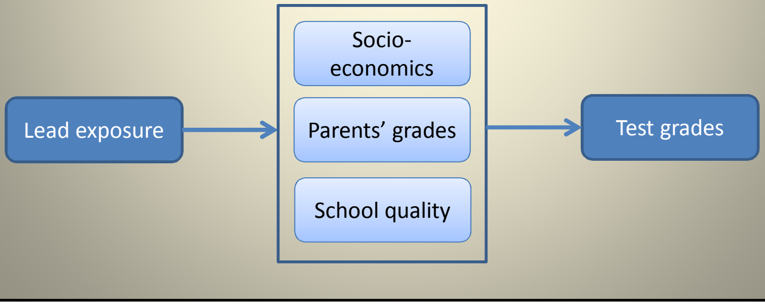
- If working memory underlies mental manipulation, then it should be related to lots of abilities.
- How do we measure this?

## Experimental vs. individual-differences approaches to studying psychology

- Experiments *manipulate* through *random assignment.*
- Individual-differences studies examine *correlations*.
- Examples:
  - Lead exposure and intelligence
  - Gender and language ability
  - Caffeine use and memory

# Experimental vs. individual-differences approaches to studying psychology

- Role of *confounding variables*
  - Experiments: Should come out in the wash because of random assignment
  - Individual-differences: Try to include them and account for them:


Lead exposure

Socio-economics

Parents' grades

School quality

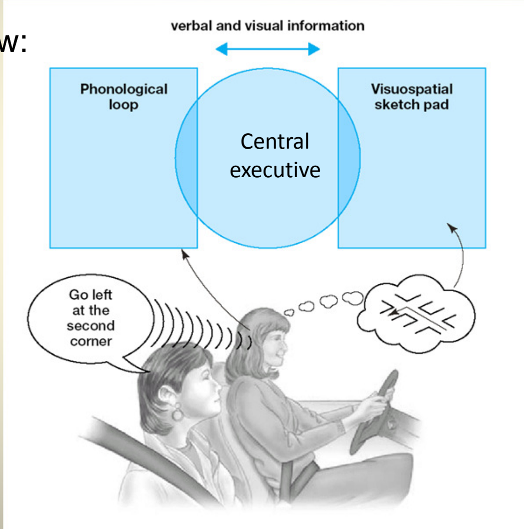
Test grades

# Relationships to working memory

- *Reasoning*: syllogisms, word problems, classification, analogies, mathematical reasoning (Kyllonen & Christal, 1990)
- *Free recall*: remembering random lists of words with no cues (Unsworth, 2009)
- *Alzheimer's disease*: lower span predicts increased incidence of DAT (Rosen et al., 2002)
- *Reading ability*: higher span leads to better understanding of texts (Daneman & Carpenter, 1980)

# Structure of working memory

Driving somewhere new:



# Next class:
# NO CLASS